DOCUMENT RESUME

ED 268 034 SO 017 017

AUTHOR Hart, Jeffrey A.
TITLE Using Microcomputer Simulations in the Classroom: Examples from Undergraduate and Faculty Computer Literacy Courses.
PUB DATE 85
NOTE 17p.; Paper presented at the American Political Science Association Conference (New Orleans, LA, August 29-September 1, 1985).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Literacy; *Computer Simulation; Directories; Disarmament; *Foreign Policy; Higher Education; Instructional Materials; International Relations; Nuclear Warfare; Political Science; Politics; Social Change; Undergraduate Study; War

ABSTRACT

Examples of the use of computer simulations in two undergraduate courses, (American Foreign Policy and Introduction to International Politics), and a faculty computer literacy course on simulations and artificial intelligence, are provided in this compilation of various instructional items. A list of computer simulations available for various mainframes and microcomputers provides information on software titles, appropriate hardware, vendors, and prices under the following headings: heads of state, nuclear war, conventional programs, submarine and naval, guerilla war, arms races, colonial war, ecological and environmental, elections and social choice, and miscellaneous. A list of vendor addresses and telephone numbers is followed by a copy of a handout given to students who were asked to use simulations in an Introduction to International Politics course. A course outline for a faculty computer literacy course on simulation and artificial intelligence concludes the paper. (LH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED268034

Using Microcomputer Simulations in the Classroom:

Examples from Undergraduate and Faculty Computer Literacy Courses

by

Jeffrey A. Hart
Associate Professor
Department of Political Science
Indiana University
Bloomington, IN 47405

Prepared for delivery at the 1985 Annual Meeting of the American Political Science Association, the New Orleans Hilton, August 29 - September 1, 1985.
Copyright by the American Political Science Association.

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Jeffrey A. Hart

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SP017017

This article consists primarily of a series of stories about how I used computer simulations in two undergraduate courses (American Foreign Policy and Introduction to International Politics) and a faculty computer literacy course on simulations and artificial intelligence. Various useful items are included: a) a list of computer simulations available for various mainframe and microcomputers, b) a copy of a handout given to students who were asked to use simulations in a class assignment, and c) an abbreviated version of a course outline used for a faculty computer literacy course on simulations.

Simulations have been used in classrooms for a long time. In the 1960s, it was common to see instructors of courses on international politics, for example, using a simulation called the Inter-Nation Simulation (INS) invented by Harold Guetzkow at Northwestern University. This simulation could be played without any computer support. Each player simply sent messages to all the others and to some central controller who acted as an umpire and introducer of random events. Some instructors chose to use computers for calculating the initial values of variables for each round of a simulation (if there was a quantitative side to the simulations, as there often was). These were called man-machine simulations and had the advantage over purely human simulations of allowing for greater complexity without slowing down the action.

With the introduction of less expensive forms of computing power, first in the form of time-sharing terminals and later inexpensive microcomputers, it has become possible to expose more students to relatively complex simulations. The fast response of time-sharing computers and micros makes for a much more stimulating computer environment than the older "batch process" environment. Interactive computing greatly reduces the time needed to program new software. A great increase in the variety of software available has been one result. There are, however, some interesting difficulties in actually using the new materials in courses.

First, one has to find out what software is available for the machines that are accessible to students. This is no easy matter, as there is no single source which has a comprehensive and/or up-to-date listing of the available software. Table 1 below is a meager attempt to correct this lacuna. Close reading over several years of computer magazines like Byte, Infoworld, PC, Creative Computing, Computer Entertainment, and others was required to compile the list. Often people who write simulations are on extremely meager budgets and can only afford to advertise once. Sometimes people who write simulations disappear after the first ad comes out. An example of this was a company called Apollo Software which published a program called "Global Thermonuclear War." I actually managed to purchase a copy of this program just before the company disappeared from the face of the earth. When one of my students managed to erase the copy-protected disk, it took me several months of trying to get another copy to find out that Apollo Software no longer existed.

Table 1. List of Simulation Software Available for Various Computers Which is Suitable for College Courses

Name	Machine	Vendor	Price
	HEADS OF STATE		
Pretend you're the Prime Minister of Israel	PLATO	CDC	
Be the President of the US	PLATO	CDC	
Monarch	Atari	Dynacomp	$16
Chancellor of the Exchequer	Atari	Dynacomp	$30
Nation	Apple	Dynacomp	$20
	WAR		
A. Nuclear			
*B-1 Nuclear Bomber	IBM, Atari & Apple	Avalon Hill	$21
*Armageddon	IBM	Social Software	$30
B. Conventional			
Global Political Exercise	Cyber	POLIS Network	
Computer Diplomacy	IBM	Avalon Hill	$50
Midway Campaign	IBM, Apple, Atari	"	$21
Dnieper River Line	"	"	$30
*Call to Arms	IBM	Strategic Simulations	$15
Geopolitique 1990	Apple	"	$40
RDF 1985	Apple	"	$35

Baltic 1985	Apple	"	$35
Tigers in the Snow	IBM, Apple	"	$40
Knights of the Desert	IBM, Apple	"	$40

C. Submarine and Naval

Gato	IBM	Spectrum Holobyte	$40
Computer Bismarck	Apple	Strategic Simulations	$60
Carrier Force	Apple, Atari	"	$60
Pursuit of the Graf Spee	Apple	"	$60
Broadsides	Apple, Atari	"	$40
Fathoms 40	Apple	Datasoft	$25

D. Guerrilla War

*VC	IBM, Apple	Avalon Hill	$25

E. Arms Races

Richdemo	Apple	Polymath	$30
*Richardson Arms Race	IBM	SSMR	$10
*Prisoner's Dilemma	IBM	SSMR	$10

F. Colonial War

Colonial Conquest	Atari	Strategic Simulations	$40

ECOLOGICAL AND ENVIRONMENTAL

*Valdez	IBM & Atari	Dynacomp	$20
Predation	Apple	Conduit	$50
Ecology Simulations I	Apple	Creative Computing	$25
*Three Mile Island	Apple	Muse	$40
*Nuclear.bas	IBM	public domain	
Mount St. Helens	Atari	Dynacomp	$18
Epidemic!	IBM, Apple	Strategic Simulations	$35
Cell Defense	IBM, Apple	Human Engineered Software	$30
Pollute	IBM	Diversified Educational Enterprises	$70
*Tragedy of the Commons	IBM	SSMR	$10

ELECTIONS AND SOCIAL CHOICE

*Nomination	IBM	Brady	$30
Nominee '84	Apple	SSMR	$10
Presidential Election	Apple	SSMR	$10
Presidential Power	Apple	SSMR	$10
*Watergate	Apple	SSMR	$10
*Votedemo	IBM	SSMR	$10
*Banzshap	IBM	SSMR	$10
Jury Trial II	IBM	Navic Software	$49
President Elect	Apple	Strategic Simulations	$40

BUSINESS AND ECONOMIC

Millionaire, Tycoon, Baron & Squire	IBM, Apple, Atari	Blue Chip	$45 each
Executive Suite	IBM	Armonk	$40
Bank President, High-Tech Entrepreneur, & Venture Capitalist	IBM, Apple	Lewis Lee	$80 each
Biznes	Apple	Conduit	$65
Management Simulator	Atari	Dynacorp	$24
Cartels and Cutthroats	IBM, Apple	Strategic Simulations	$40

MISCELLANEOUS

*Heroism in Modern Age	IBM	Pacific Infotech	$59
*ELIZA	IBM, Apple	Artif. Intell. Research Group	$45
Racter	IBM	John D. Owens	$70
*Neighborhood Segregation	IBM	SSMR	$10
Diffusion Game	Apple	Conduit	$55

Notes: Simulations marked by an asterisk (*) above have been tested by the author. Four programs listed above were written (or coauthored) by the author: Neighborhood Segregation, Prisoner's Dilemma, Richardson Arms Race Model, and Tragedy of the Commons. Vendor addresses and phone numbers can be found in Table 2. Some of the programs listed above are also available for CP/M, Commodore, TRS, and other computers.

Table 2. List of Vendors with Addresses and Phone Numbers

Armonk Software
(Available through discount vendors like Conroy-Lapointe)

Artificial Intelligence Research Group
921 North La Jolla Ave.
Los Angeles, CA 90046
(213) 656-7368

Avalon Hill Game Company
4517 Harford Road
Baltimore, MD 21214
(301) 254-5300

Blue Chip Software
6744 Eton Avenue
Canoga Park, CA 91303
(818) 346-0730

Brady Company
A Prentice-Hall Company
Bowie, MD 20715
(301) 262-6300

Conduit
The University of Iowa
Oakdale Campus
Iowa City, IA 42242

Creative Computing
39 E. Hanover Ave.
Morris Plains, NJ 07950
(800) 631-8112

Datasoft
9421 Winnetha Avenue
Chatsworth, CA 91311
(818) 701-5161

Diversified Educational Enterprises
725 Main Street
Lafayette, IN 47901
(317) 742-2690

Dynacomp
1064 Gravel Road
Webster, NY 14850
(716) 671-6160

Human Engineered Software
150 North Hill Drive
Brisbane, CA 94005
(415 468-4111

Lewis Lee Corporation
P.O. Box 51831
Palo Alto, CA 94303
(415) 853-1220

Muse Software
347 N. Charles St.
Baltimore, MD 21201
(301) 659-7212

Navic Software
North Palm Beach, FL
(305) 627-4132

John D. Owens
12 Shubert St.
New York, NY 10305

Pacific Infotech
10850 Wilshire Blvd.
Suite 800
Los Angeles, CA 90024
(213) 470-7590

Social Software
P.O. Box 7207
Dearborn, MI 48121

Spectrum Holobyte
2006 Broadway, Suite 301
Boulder, CO 80302
(303) 443-0191

SSMR Software
Box 8101
North Carolina State University
Raleigh, NC 27695
(919) 737-3067

Strategic Simulations
883 Stierlin Road, Bldg. A-200
Mountain View, CA 94043-1983
(800) 227-1617

Most of the categories in Table 1 are self-explanatory. I suggest that anyone contemplating the purchase of this sort of software should be sure to consult reviews in at least one independent computer magazine before buying. Also, I have omitted many of the details concerning the minimum configurations required for running the simulations (e.g. color monitors, amount of random-access memory, etc.). I have written a review of seven of the above programs in the Social Science Microcomputer Review, Vol. 3 (Summer 1985).

Matching software to machines was not easy. Because of the limited market for simulations and the highly decentralized production process involved (mostly individual enthusiasts writing for small companies for pitifully small remuneration), it was unusual at first for a given piece of software to be available for more than one machine. But increasingly, software companies are trying to write software that can be easily converted to a variety of machines, so this is becoming much less of a problem.

At Indiana University, we have a pretty rich choice of machinery. Indiana has around 16 PLATO terminals, through an agreement with Control Data and the University of Illinois (the current owners and operators of the PLATO system). There are a number of simulations on the PLATO system, only two of which were directly relevant to my courses on international politics: both of them involve decision-making in a crisis in the Middle East and were written by a team at Cornell University under the direction of Prof. Richard Rosecrance. These simulations consist of a series of multiple choice questions where the next question depends on the answer to the current question. The branching is entirely determined by the choices made by the student playing the simulation. Despite the rigidity of this framework, the PLATO simulations give students a feel for making hard choices in highly conflictual situations. Because they allow the student to set goals for themselves before beginning the simulation, there is a clear way for them to evaluate their own performance which is not imposed by the programmers.

When one uses microcomputer simulations, the main difficulies are 1) getting access to machines, 2) making it easy for a student with minimal exposure to computers to start the simulations, and 3) staying legal. Indiana University's computers are under the control of the Bloomington Academic Computing Service (or BACS). There are several mainframes (CDC and CYBER) and minicomputers (Digital VAXs) and several clusters of terminals. BACS has recognized the need for increasing the availability of computing beyond mainframes, but has tended to take the high road in supporting only the most expensive microcomputers on the grounds that the less expensive varieties are incapable of serious computing. There has been at times a bit of a problem with the BACS mainframe types who would just like all those microcomputer enthusiasts to go away so that they could be alone with their machines (just like the good old days). Also, BACS (like any other central computing authority) is concerned that people not violate license and copyright agreements when using their software, because they are legally responsible for such violations. This makes them somewhat overly cautious and inflexible. Thus, instructors are tempted to bypass the computer centers when setting up programs for instructional computing.

There is a cluster of 8 PLATO terminals and 16 IBM PCs in the Main Library. There is also a bank of IBM PCs (about 20) available only for faculty or staff who belong to a club called ACCESS in the student union. There is also a group of about 20 Apples in the School of Education which anyone with a university ID can use. I favored the IBMs at the library because they seemed easier to find and use than the Apples. Since I had a CP/M computer at home, I was not about to learn a third operating system. So the first problem was to find some simulations involving international politics which could be run on IBM PCs. The result was the list in Table 1.

BACS was willing to purchase copies of some of these simulations so that they could be used in a faculty computer literacy course in the Spring of 1985. I intended to use them in undergraduate courses as well. However, most of the programs are copyrighted and therefore it would be illegal to simply copy and distribute them, so I had to ask the library to put the software owned by BACS or by me on reserve at the undergraduate reserve desk where it could be checked out and taken to the library's IBM cluster (conveniently located right next to the reserve desk). Although it would be difficult to steal software from the library (because passing through the magnetic detectors would probably ruin the disks), it would not be difficult for the students to either erase the disks through understandable but regrettable errors or to ruin them while trying to steal them. Nevertheless, we took the risk and there was no major abuse. One program, however, did get erased. The library's confidentiality rules forbade revealing the name of the student responsible for the erasure. After that experience, I stopped putting software on reserve unless it was possible to make back-up copies. Another obvious rule of thumb was never to put an original copy of the documentation on reserve.

There were still a few further difficulties. Some programs required color monitors rather than the cheaper and more widely available green or amber monitors. This fact had to be impressed upon the students in handouts (see Table 3). Also, to reduce the difficulty of getting started it was useful to set up self-executing batch files (AUTOEXEC.BAT) so that merely inserting a disk and turning on the machine would start the program. This was not always possible, as some disks had more than one simulation one them.

The first time I asked students to use microcomputer simulations, I made the assignment voluntary. They could get extra credit however for writing about the experience and especially for offering suggestions on how the simulation could be improved to make it more realistic, more educational or simply more fun to play.

A number of students got very enthusiastic about a simulation called B-1 Nuclear Bomber. This simulation asked the student to make decisions for the pilots of a B-1 bomber assigned to bomb a specific city inside the Soviet Union during a nuclear war. The students found this exciting and unnerving. It illustrated the great distances that had to be traveled and the low probability of survival of any bomber attack, even a bomber with the extremely sophisticated weaponry of a B-1.

A few others found a simulation named Call to Arms interesting. This simulation involves choices about increasing armaments or attacking neighboring territories. There is a map of Europe (not unlike the map used in the board game, Diplomacy) and the simulation starts with each player being assigned a set of territories on the map. Like Diplomacy, Call to Arms demonstrates the operation of a balance of power system by making it relatively difficult for any one state to defeat all the others.

One of the students for this course got sufficiently excited about the idea of using microcomputers to simulate international politics that he volunteered to write an original simulation in lieu of a term paper. His simulation was based on the "prisoner's dilemma" in game theory and asked the player to play against a variety of types of opponents and over a series of rounds. I worked with this student to convert his program to the IBM-PC and we are now distributing it through the Social Science Microcomputer Review (see SSMR Software in Table 2). The student, who was a senior and who had recently changed his major from computer science to political science, decided to apply for admission to a number of graduate programs in political science partly as a result of our success in writing and selling the prisoner's dilemma program.

The second undergraduate course in which I used the simulations was my introduction to world politics, taught in the Spring of 1985. This time I required that all the students in the class use at least one of the simulations and write a short paper about what happened (see the copy of their assignment in Table 3). Most of the students opted to use the PLATO simulations probably because the PLATO terminals were less intimidating than the IBM-PCs. One of the key problems with PCs, in my opinion, is that you become highly dependent on the quality of consultants available to the students. If the consultants are not extremely friendly and helpful, students may shy away from PCs because of the problems of getting started. In any case, since the class was large (150 students), at least 50 did use the microcomputer simulations. The papers varied greatly in quality, but most of them seemed to demonstrate that the simulation gave the student an experience to think about. Several students returned to issues raised in the simulations in their final examinations, especially in considering questions concerning arms races and war.

Finally, I am providing in Table 4 an abbreviated version of the course outline for my faculty computer literacy course on simulations and artificial intelligence. The reader will note that after introducing the members of this course to "canned" (commercially available) simulations, I tried to get them to write their own simple simulations, first with spreadsheet programs (like Lotus 1-2-3 or Supercalc) and then with high-level languages (like Basic and Pascal). More than half the course was devoted to an introduction to the artificial intelligence language, LISP, which is not directly relevant for this article. As a result of this somewhat overly ambitious program, few of my faculty-member students produced any major computer simulations by the end of the course. Nevertheless, they were introduced to the basic principles and a number of methods which could be used to produce their own simulations. Several of them indicated to me that they intended to use commercial simulations in their courses.

Table 3. Handouts to Students in an Introductory International Politics Course

Y109 Introduction to World Politics Spring 1985

First Lab Assignment

For this assignment you are required to use a computer simulation of international politics. You may choose any one of the simulations described below. After playing the simulation, you must write a brief summary of what happened when you played it, outlining what you think you learned from it and criticizing the simulation itself. Criticism can be both positive and negative. You should include suggestions for how you would make the simulation more realistic, exciting, etc. — using whatever criteria you deem appropriate. Your written work should be three pages or less, typed and double-spaced.

SIMULATIONS AVAILABLE TO ALL Y109 Students

I. PLATO SYSTEM

There are two foreign policy simulations available for students to experiment with on the PLATO system. There are about 8 PLATO terminals in the main library; others can be found in the School of Education, 2nd floor, and the computer center in Memorial Hall.

The computer center consultants can tell you how to use the PLATO system, but we will try to give you most of what you need to use the programs.

The first thing you do after you sit down at a terminal is to type the NEXT key. This results in your being asked what "family" you belong to, to which you should respond by typing "social sciences" -- then it will ask you for a group name to which you reply "iuplato." [don't type the quotation marks or periods] It then asks you to pick one of the social sciences listed. In this case, you should type the number corresponding to political science. Now it will ask you to choose one of the political science programs. The two we are interested in are "a" (pretend you're the Prime Minister of Israel) and "g" (be the President of the US). After that just do what the programs tell you to do. If nothing happens at various points, try hitting the NEXT key to keep going.

II. IBM-PC Microcomputers

The following IBM-PC programs will be available for the use of members of this class at the undergraduate reserve desk of the main library. There are a cluster of IBM-PCs available for your use (you have to surrender your IU ID card) to the right as you enter the undergraduate part of the main library. You must ask for the program by name. They were put on reserve originally for Y360 American Foreign Policy (and are listed in the catalog under that course). You may have to tell the person at the desk to check the area near the computer manuals. If you have trouble using the PCs, ask the consultants who are on duty to help you.

1) Heroism in the Modern Age — to use this game you place the disk in the left drive (drive A) and either turn on the machine or reboot (see instructions above). This is a role-playing simulation. Again you should read the instructions carefully before playing the game. You can stop at any time by hitting control-C. You can also stop by hitting the F1 function key. This allows you to stop the game and start where you left off later on. Can be played on a monochrome monitor.

2) B-1 Nuclear Bomber -- to use this game you put the disk in the left drive and turn on machine or reboot, at the A> prompt you type BASICA B1 followed by a return. You can stop at any time by hitting control-break. It takes a long time to play, so you may not want to start unless you have a lot of time. The playing instructions are somewhat sketchy. To find out where you are you must type NA plus two more letters representing the first two letters of places in the Soviet Union (all of which are represented on the game map). The best way to get location is to type the four letters and then hit return. Can be played on a monochrome monitor.

3) Call to Arms -- to use this game, put the disk in the left drive and turn on machine or reboot. You cannot stop the game except by turning off the machine (a strange feature which should be changed by some skillful person). Read the instructions. Can be played with a monochrome monitor.

4) Prisoner's Dilemma -- to use this game, put the disk in the left drive and turn on machine or reboot. You can stop the game by hitting CONTROL-C. This game keeps a record of your plays and that of your opponent in a file called results text. To get a print out of that file after your finish playing, type the following after the A> prompt: TYPE:RESULTS.TXT <CONTROL-P> <ENTER> When it finishes printing, hit <CONTROL-P> <ENTER> again if you want to play some other game, otherwise it will keep printing everything you see on the screen.

5) Tragedy of the Commons -- to use this game, put the disk in the left drive and turn on machine or reboot. You can stop the game at any time by hitting CONTROL-C.

III. WRITE YOUR OWN COMPUTER SIMULATION

See the instructor for suggestions.

Table 4. Course Outline for Faculty Computer Literacy Course on Simulation and Artificial Intelligence

PREREQUISITES: To insure some uniformity of backgrounds, it will be assumed that members of the class have either taken the level I computer literacy courses, or their equivalents. Owning and using a CP/M or IBM personal computer for six months or more may also provide adequate background. Class members who have experience using word-processing packages, spreadsheets and at least one computer language will get a lot more out of this course than those who find all this completely new.

This class is offered for the benefit of IU faculty, staff and students.

I. Outline of the Course

A. Week I - main purpose: to familiarize class members with available hardware - i.e. BACS mainframes, PLATO terminals, IBM-PCs and CP/M microcomputers

The readings and lecture will emphasize practical problems of logging on to machines, getting around on their operating system, and using text editors. (For IBM PC-DOC, see the PC-DOS manuals at the ACCESS cluster, or on reserve at the undergraduate library. Another good source is Van Wolverton, Running MS-DOS.)

B. Week II - main purpose: to review fundamentals of Week I, and to demonstrate some of the simpler simulations already available at IU

The lecture will consist of hands-on demonstration of IBM-PC simulations called Call to Arms, Heroism in the Modern Age, B-1 Nuclear Bomber, Valdez (navigating a supertanker through the straits of Valdez in Alaska), Nomination and Armageddon; an Apple II simulation called Three Mile Island. The manuals and disks for these programs will be available to members of the class at the main desk of ACCESS.

C. Week III - main purpose: to continue demonstration of simple simulations

The class will be exposed to simulations of verbalizing which were the starting point for contemporary Artificial Intelligence natural-language programming. The programs to be demonstrated are: ELIZA, Fetch (a program that parses simple declarative sentences) and Haiku (a program that writes Haiku poems). All are written in BASIC and are public domain programs that can be copied and modified by class members.

Source for Fetch and Haiku: John Krutch, Experiments in Artificial Intelligence for Small Computers (Indianapolis: Sams Publicatns., 1981) and see manual for ELIZA at ACCESS desk.

D. Week IV - main purpose: to get members of the class to write simple simulations using high-level languages like BASIC and PASCAL or spread-sheet programs on micro-computers

The instructor will discuss the principles behind a several BASIC simulations (Tragedy of the Commons, Segregation, and Streets of the City). and a PASCAL simulation of military arms races (Richardson Arms Race Model) and of a mixed-motive conflict process (Prisonner's Dilemma).

Readings:

Art Matheny, "Simulation with Electronic Spreadsheets." Byte (March 1984), 411-414.
Edwin Dethlefsen and Carlisle Moody, "Simulating Neighborhood Segregation, Byte (July 1982), 178-206
David Ahl (ed.), Big Computer Games (Creative Computing Press)
C.W. Engel, Stimulating Simulations, 2d edition (Rochelle Park, NJ: Hayden Press, 1977).
further documentation available at ACCESS desk

E. Week V - main purpose: introduce specialized simulation and artificial intelligence languages, focusing this week on LISP

Those class members with BACS accounts may try their hand at Scheme LISP on the Blue VAX; others will be given a chance to try a version of LISP called GCLISP which is available for the IBM-PC; those with IBM or CP/M machines will be able to use a public domain version called XLISP.

F. Week VI - main purpose: same as Week V only more on LISP and brief introduction to a numerical simulation language for the IBM-PC (Micro-Dynamo)

Readings: Nancy Roberts, David Andersen, Ralph Deal, Michael Garet, and William Shaffer, Introduction to Computer Simulation: The System Dynamics Approach (Reading MA: Addison-Wesley, 1982) - recommended text to go with Micro-Dynamo software

---

Several tools were available to me for the faculty computer literacy program that I wish I had been able to use in my undergraduate courses. The first was the ACCESS center, which was a classroom in the student union which contained about 20 IBM-PCs with printers attached. Also in the ACCESS classroom was a machine for projecting the image from a computer monitor onto a screen so that most of the members of the class could see it. This projector was quite unreliable and hard to focus. Nevertheless, without it it would have been impossible to demonstrate the simulations to all the class members simultaneously. The type of projector we used was not as good as one which is used in the School of Education, a Sony machine, which produces a much sharper picture and can project color as well as green or amber images.

In the last item of Table 4, you will see a reference to a "simulation language" called Micro-Dynamo. This is a language published by Addison-Wesley that allows you to write a series of commands in a file which tells the program how to set up a specific numerical simulation model. The Micro-Dynamo package includes several examples of numerical simulations: 1) version II of the World Model by Jay Forrester made famous by the publication of the Club of Rome's report, The Limits to Growth (1973), 2) a rabbit-lynx prey-predator model, 3) an influenza epidemic model, 4) a retail store simulation, 5) a heroine addiction and crime rate simulation, 6) a simple model of urban growth, 7) a model of the ecology of the Kabib plateau, and 8) two market simulations for pork and natural gas. It also includes a well written manual that explains how to write you own simulations. The graphics in Micro-Dynamo are fairly pedestrian, but otherwise it seems to be a pretty solid program. For around $300 you get a very useful laboratory tool. I suspect, however, that there will soon be cheaper alternatives. Also, it is not a great deal harder to write a simulation in Basic or Pascal than it is to write one in the Micro-Dynamo language. Since Turbo Pascal markets for less than $50, anyone with a budgetary constraint will tend to opt for that inexpensive but high performance language.

Simulations can be very helpful in exposing students to more rigorous ways of thinking about phenomena in a way which is consistent with the current generation's preoccupation with video images and arcade action. Teaching with simulations, to be truly useful in encouraging critical thinking, should include carefully designed feedback mechanisms to get students to verbalize about the simulations they have experienced. They should be encouraged to criticize simulations for lack of realism and to propose alternative ways of modelling the phenomena in question. The more programs integrate real data into the simulations, the more likely that students will become curious about the relationship between simulation models and the real world. Also, they should be taught how to write their own simulations. This is one of the best ways to teach modelling techniques. With the advent of inexpensive decentralized computing, it is now possible to do this much more easily than only a few years ago.